

5 FIG. 10 is a flowchart illustrating still another preferred embodiment of the reproducing method according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

10 An example of data recorded in an optical disc according to a preferred embodiment of the present invention is shown in FIG. 1. Referring to FIG. 1, main data, sub data, and extra data are recorded in the optical disc in separate bitstreams. Here, the main data have corresponding sub data and extra data. However, not all the main data have corresponding sub data and/or corresponding extra data.

15 Main data refer to data that can be independently reproduced. For example, a movie including both video data and audio data may be a kind of main data. Sub data refers to additional data to main data, which contains components to be reproduced in synchronization with the main data. For example, sub-picture data to be reproduced as caption data along with video data recorded in a digital versatile disc may be a kind of sub data. Extra data refers to additional data associated with main data, including an Internet link with respect to a particular scene of a movie, a movie script, an actor's profile, and a bonus clip. Extra data are, but not necessarily, reproduced in synchronization with main data.

20 Sub data and/or extra data corresponding to main data can be recorded along with the main data at the same time or sequentially with a time gap. When the sub data and/or extra data and main data are recorded at the same time, a recording unit of an optical pickup alternately records the main data and corresponding sub data and/or extra data.

25 Although sub data and/or extra data are generally reproduced in synchronization with main data, the sub data and/or extra data may be recorded separately from corresponding main data. For example, only a sound track recorded as sub data of a movie, or only a movie script recorded as extra data of the movie may be output.

30 FIG. 2 shows the structure of navigation information showing the relation between the main data, sub data, and extra data of FIG. 1. Navigation information refers to control information required for easy searching and controlling multimedia contents stored in storage media including digital versatile discs (DVDs),

Referring to FIG. 2, main data are associated with at least one sub data and/or extra data. The main data on the top of the structural diagram of FIG. 2

have one sub data and one extra data as additional data, next main data have only sub data as additional data, and next main data have only extra data as additional data.

5 In particular, navigation information includes identifiers for particular bitstreams and playback time information on additional data corresponding to main data.

10 FIG. 3 is a block diagram of a preferred embodiment of a recording apparatus according to the present invention. The recording apparatus according to the present invention may be an apparatus used by a manufacturer in the production of an optical disc such as DVDs, or an apparatus used by general users to record desired multimedia contents.

15 Referring to FIG. 3, the recording apparatus includes a control unit 31, a recording unit 32, a digital interface 34, and an encoder 35. Here, the digital interface 34 is for receiving external digital signals, for example, for receiving multimedia data including main data (and additional data), through a network. The encoder 35 receives and encodes main data or additional data, and transmits the coded main data or additional data to the recording unit 32. The recording apparatus may include only the digital interface 34 or the encoder 35 if necessary.

20 The recording unit 32 records the main data input from the digital interface 34 or the encoder 35 and additional data including sub data and/or extra data in separate bitstreams in an optical disc 300.

25 The control unit 31 generates navigation information defining the relation between the main data, the sub data and/or extra data and transmits the navigation information to the recording unit 32. The recording unit 32 also records the navigation information in a predetermined area of the optical disc 300. In a recording operation, the recording unit 32 radiates a laser beam onto the optical disc 300 through an optical pickup (not shown) based upon the control signal from the control unit 32.

30 In particular, all data are recorded to form a contiguous data area (CDA) to ensure normal reading and reproduction by a reproducing apparatus. In other words, data are recorded to ensure that a decoder can continuously supply data even when data reading is temporarily interrupted by movement of an optical head of an optical pickup in the reproducing apparatus.

FIG. 4 is a block diagram of a preferred embodiment of a reproducing apparatus according to the present invention. The reproducing apparatus may be an apparatus used by general users to reproduce desired multimedia contents.

Referring to FIG. 4, the reproducing apparatus includes a control unit 41, a reading unit 42, a multiplexer 43, a digital interface 44, and a decoder 46. Here, the digital interface 44 is for externally transferring a digital signal, for example, transferring multimedia data including main data (and additional data) through a network. The decoder 46 decodes main data and/or additional data, which have been encoded and written, and read by the reading unit 42, and outputs the decoded main data or additional data to an output device, such as speakers or monitors (not shown). The reproducing apparatus may include only the digital interface 44 or the decoder 46 if necessary.

The reading unit 42 reads data recorded in an optical disc 400 by radiating a laser beam onto the optical disc 400 through an optical pickup based upon the control signal from the controller 42 and by converting the laser beam reflected from the optical disc 400 to an electrical signal. The reading unit 42 simultaneously reads the main data and the additional data including the sub data and/or extra data and transmits the read data to the multiplexer 43. The read bitstreams may be a combination of main data, sub data, and extra data, a combination of main data and sub data, and a combination of main data and extra data, a combination of sub data and extra data, etc. When at least two bitstreams are simultaneously read, an optical pickup of the reading unit 42 alternately reads the multiple bitstreams. The reading unit 42 has a buffering function so that it can continuously supply data to the decoder 46 even when data reading is temporarily interrupted in a reproducing operation by movement of an optical head of the optical pick.

The multiplexer 43 multiplexes the main data, the sub data, and/or the extra data, which have been separately received, based upon the navigation information. The multiplexer 43 can replace one component of main data with separate sub data and/or extra data. For example, if main data is a video title in which video data, audio data and/or extra data are multiplexed, the audio data and/or caption data can be replaced with corresponding sub data. A multiplexed bitstream output from the multiplexer 43 is externally transferred through the digital interface 44 or is decoded by the decoder 46.